

Lycopodium australianum (Herter) Allan on Subantarctic Macquarie Island

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The species of *Lycopodium* on subantarctic Macquarie Island has been variously ascribed to *L. selago*, *L. varium*, *L. saururus*, *L. australianum*. From a careful consideration of the growth habit, general and spore morphology of these species, it is clear that the plant should most appropriately be referred to *L. australianum*.

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INTRODUCTION

Macquarie Island (54° 30' S, 158° 57' E) is an isolated subantarctic island situated about 1580 km SSE of Tasmania, 1130 km SW of New Zealand and 1530 km N of the Antarctic continent. The island is approximately 34 km long, 2.5-5 km in width, and 120 km² in area. Steep cliffs bound a lake-dotted plateau of about 250 m altitude with peaks to 433 m. The climate is extremely equable, cold, wet and windy. The island lies close to, but north of, the Antarctic convergence.

Vegetation formations have been described by Taylor (1955), with further recent discussion by Seppelt, Copson and Brown (1984), Smith (1984) and Selkirk, Seppelt and Selkirk (1990). Tall tussock grassland predominates on beach terraces and steep coastal slopes. Herbfield occurs on the wetter raised beach terraces and in some upland areas. Short grassland (sub-glacial herbfield of Taylor, 1955) and feldmark, typically with much less than 50% vegetation cover, are widespread on the plateau uplands. The vegetation in much of the feldmark is dominated by bryophytes and cushion plants such as *Azorella macquariensis*. Vegetation patterning in stripes or terraces is common (Selkirk and Seppelt, 1984; Selkirk, Adamson and Seppelt, 1988). There are many ecotonal associations between short grassland and feldmark.

RECORDS OF *LYCOPodium* FROM MACQUARIE ISLAND

Since the species was first collected in 1824, the *Lycopodium* from Macquarie Island has been ascribed to *L. selago* (Anon., 1894), *L. billardieri* var. *varium* (Hamilton, 1894), *L. varium* (Cheeseman, 1919), *L. saururus* (Taylor, 1955) and *L. australianum* (Given, 1978). The first recorded collection of plants from the island was made by sealers and forwarded in 1824 by J. H. Fraser, Superintendent of the Sydney Botanic Gardens, to W. J. Hooker at Kew. Attached to a sheet of *Azorella selago* (now *A. macquariensis* Orchard, 1989) was a specimen named *Lycopodium selago* (Anon., 1894).

In 1894 A. Hamilton collected specimens of *Lycopodium* about which he later remarked: 'The habit is like that of *L. selago*, but denser; the leaves are much broader. Seedling plants growing amongst the stems have distant oblong leaves.' (Hamilton, 1894: 569). Kirk identified these specimens as *L. billardieri* Spreng. var. *varium* (Hamilton, 1894), equivalent to *L. varium* R. Br. (Cheeseman, 1919). Cheeseman (1919: 41), in examining collections made in 1911-14 by H. Hamilton, stated that the specimens were of the '... habit and appearance of *L. selago*, from which they differ mainly in forming dense much-branched compact tufts, often with an even surface at

the top. The leaves are larger, broader, and more coriaceous . . . numerous gemmae occur among the leaves . . . the fructification is much more like that of *L. selago* than that of the usual state of *L. varium*, for in most cases the sporangia are produced for a considerable distance down the branches in the axils of unaltered leaves.'

Nomenclatural confusion has persisted in the austral lycopod flora. J. D. Hooker (1864) remarked that Tasmanian specimens of *L. varium* passed confusedly into *L. selago* on the one hand and *L. billardieri* on the other. According to B. Øllgaard (pers. comm.) *L. billardieri* is very closely allied to or even doubtfully distinct from *L. varium*.

Cheeseman (1919) noted that 'true *L. selago* has not yet been definitely recorded from any of the southern circumpolar islands; but the closely allied *L. saururus* Lam. exists in the Falkland Islands, Kerguelen Island, Marion Island, and Tristan d'Acunha.' He considered it possible that the Macquarie Island plant might be referable to *L. saururus*, but that *L. saururus* had stouter stems, and larger and narrower leaves. Cheeseman identified the Macquarie Island specimens as *L. varium*.

Holloway (1919: 167) commented that despite the narrowing of some branch apices (a characteristic of *L. varium*) and leaves that are larger, broader, and more coriaceous than those found on 'typical' *L. selago*, '. . . the presence of bulbils would seem to be an argument in favour of relating this species to *L. selago*.' Taylor (1955) referred Macquarie Island specimens to *L. saururus* on the basis that specimens examined by the Australian National Herbarium were considered identical with specimens of that species from Kerguelen. Jenkin (1972) followed Taylor in applying this name.

In his *Flora of New Zealand*, Allan (1961), in supplementary notes on *L. varium* in New Zealand, equates *L. varium* (*sensu* Cheeseman, 1919) with *L. saururus* (*sensu* Taylor, 1955). However, using his key to species, the Macquarie Island specimens are without question referable to *L. australianum* (Herter) Allan.

Godley (1969: 337) reported a *Lycopodium* sp. from the Auckland Islands with '. . . no differentiated sporophylls, and sporangia were found in one or two whorls about 1 cm below the tips of branches. The specimens match closely the "tussock-country form" or "xerophytic variety" . . . discussed under *L. selago* by Holloway (1919).' Godley (1969: 338) hesitated to name the Auckland Islands plant pending a '. . . detailed study of the status of the "xerophytic" and "mesophytic" (shade) varieties of Holloway, and the relation of the "xerophytic" variety to the lycopod on Macquarie Island, now classified (Taylor 1955) as *L. saururus*.' Johnson and Campbell (1975), in their annotated checklist of the Auckland Islands vascular flora, concurred with Godley (1969) but indicated a relationship to *L. australianum*.

Meurck (1975) reported *Lycopodium* cf. *australianum* from Campbell Island and considered this to match the Auckland Islands *Lycopodium* sp. of Godley (1969). A connection with the *L. saururus* of Macquarie Island (Taylor, 1955) was suggested by the presence of axillary bulbils.

Given (1978: 551) discussed the taxonomic, nomenclatural and morphological relationships of the *L. australianum-varium-selago* group of names in New Zealand thus:

'Meurck (1975) referred to the (Campbell Island) species as cf. *australianum* and suggested that the presence of bulbils in the axils of some leaves might indicate a connection with the Macquarie Island specimens identified by Taylor (1955) as *L. saururus* Lam. Cheeseman (1919) placed all Macquarie Island specimens in *L. varium* and later cited Macquarie, Auckland and Campbell Islands as localities for that species (Cheeseman 1925). However, on Auckland and Campbell Islands there are clearly two entities, the true *L. varium* and a very much scarcer species which I consider to be *L. australianum*. I have not seen specimens from Macquarie Island but descriptions and Fig. 2b of Holloway (1919) suggest that it is very similar to, if not identical with, plants seen

on Campbell Island and the *Lycopodium* sp. found on Adams Island, of the Auckland group (Godley 1969). These are almost identical with *L. australianum* of the New Zealand mainland, differing chiefly in having shorter stems. Until Australian mainland and subantarctic collections can be critically compared with authentic specimens of *L. saururus*, it seems best to regard specimens from Campbell, Auckland and Macquarie Islands as belonging to *L. australianum*.

Greene and Greene (1963), in the checklist of the subantarctic and Antarctic vascular flora, list two species of *Lycopodium* in the subantarctic zone. Greene and Walton (1975) published a revised and annotated checklist, including records of both *L. magellanicum* and *L. saururus* for Prince Edward Island and replacing *L. saururus* by *L. varium* for Macquarie Island. Nomenclatural uncertainty makes it difficult to evaluate the distribution of *Lycopodium* species in the subantarctic region but it appears that three species occur there (Table 1).

TABLE 1

Distribution of Lycopodium species on subantarctic islands.

*Data sources are as follows: x Greene and Greene (1963); + Greene and Walton, (1975); * (this paper).*

Species	South Georgia	Prince Edward Is.	Marion Is.	Iles Croz.	Iles Kerg.	Macquarie Is.
<i>L. australianum</i>						*
<i>L. magellanicum</i>	x	+	x	x	x	
<i>L. saururus</i>		+	x	x	x	

DESCRIPTION AND STATUS OF *LYCOPodium* ON MACQUARIE ISLAND

On Macquarie Island, the *Lycopodium* grows as small clumps of upright stems to about 10 cm tall (Fig. 1). Branches arising from the erect stems appear whorled. Leaves are up to about 6 mm long, 2-3 mm broad, tapering to a point, stiff, crowded on branches. Sporangia occur singly, in the axils of unaltered leaves, borne towards the apex of stems but not aggregated into a distinct strobilus. Numerous axillary bulbils are found near the tips of stems.

Although sporangia and spores are produced, reproduction appears most commonly to be vegetative, via the abundant deciduous bulbils, or gemmae. Lateral spread of these propagules from a parent plant appears to be limited to a few centimetres, with the propagules dropping off the shoots into the surrounding vegetation. On sprouting, propagules produce a strong tap root (Fig. 2) which quickly develops into a dense fibrous root system. No horizontal rhizome system is produced.

This *Lycopodium* has been a component of the Macquarie Island flora throughout the Holocene: fossil spores (Fig. 3) are abundant in a lacustrine deposit, Palaeolake Nuggets, in strata which have been dated at up to 9400 ± 220 radiocarbon years B.P. (Selkirk *et al.*, 1988).

Our recent field surveys confirm that *Lycopodium* deserves its rare status (Copson, 1984) on Macquarie Island although it is more widespread and locally abundant than previously thought (Fig. 4). Taylor (1955) indicated that *Lycopodium* occurred only in his *Azorella selago* alliance and was 'never found in other communities'. He observed the species in only a dozen localities on the island. 'Where it does grow, two or more plants are generally close together. Of 100 plants seen in the whole of 1950-51, over half were in a small area a few yards in diameter.' In our surveys only one area near Pyramid Lake supported any reasonable number of plants with 96 separate plants in an area 5 x 3m. Most localities contained single or less than ten separate plants.

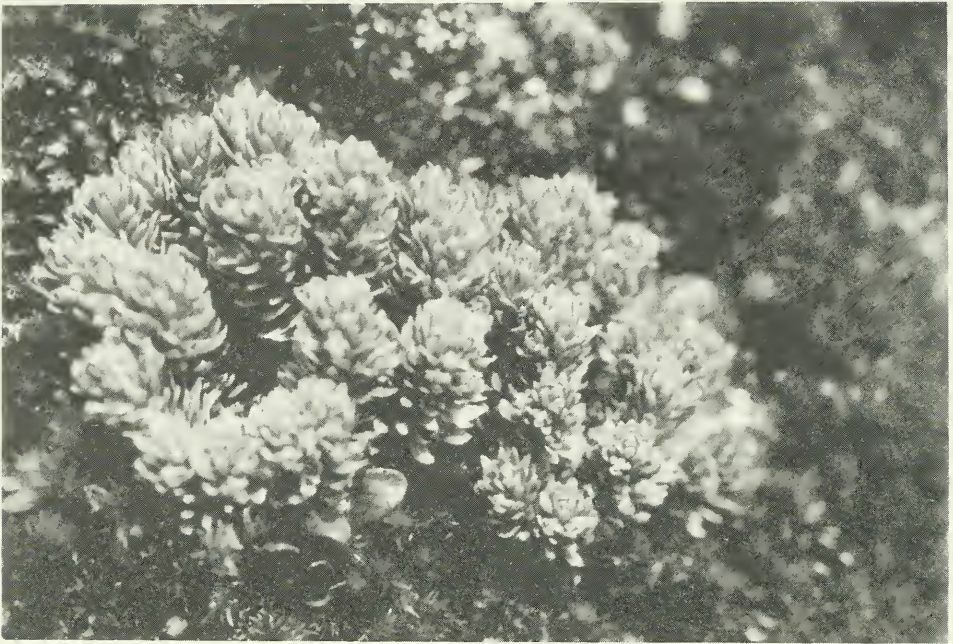


Fig. 1. Clump of *Lycopodium australianum* growing in feldmark with *Grammitis poeppigeana*, *Rhacomitrium crispulum*. Stems in this clump up to 3 cm tall.

Contrary to Taylor's (1955) assertion that the species is restricted to the *Azorella selago* alliance we have found the *Lycopodium* to be more widespread in the short grassland and in ecotonal associations between short grassland and feldmark. We have only occasionally found *Lycopodium* plants growing amongst *Azorella* cushions in feldmark. The Macquarie Island plants clearly belong to the *L. selago* group: development of gemmae from amongst the leaves is restricted to this group. However, *L. selago* is apparently restricted to the Northern Hemisphere (Ollgaard, pers. comm.).

Gemmae do not occur in *L. varium* or *L. saururus*. Both these latter species are quite different in details of growth habit and spore morphology from the Macquarie Island species (Ollgaard, pers. comm.). The position of its sporangia and absence of a distinct strobilus are quite unlike *L. varium* (Brownsey, pers. comm.). The spores of the *L. selago* group have characteristically truncated corners and distinctly pitted proximal faces. Both *L. varium* and *L. saururus* have flattened, smooth proximal faces without, or with shallow, marginal pits and they do not have truncated corners (Fig. 5).

In general growth habit, presence of bulbils, position of sporangia and absence of a distinct strobilus the plant resembles *L. australianum* (Brownsey and Smith-Dodsworth, 1989). The *L. selago* group is a complex one, consisting of a number of closely related taxa with very poor distinguishing characters. Until a thorough taxonomic revision of this group of species has been undertaken, we believe *L. australianum* is the most appropriate name to apply to the Macquarie Island material.

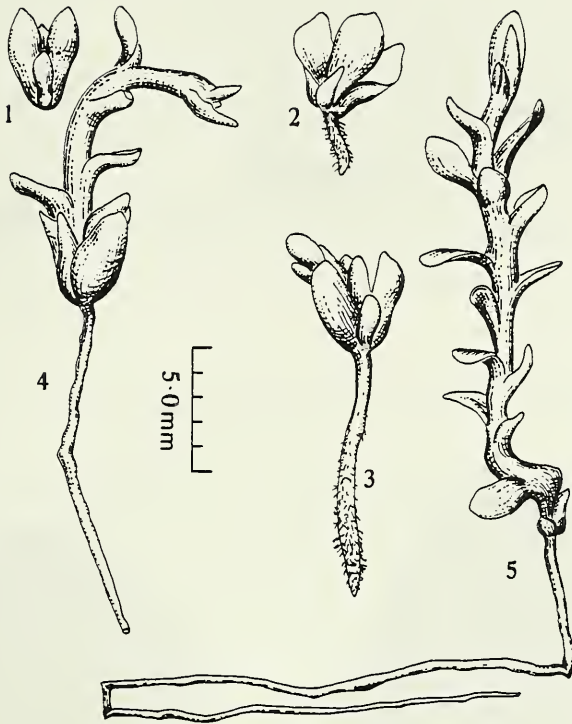


Fig. 2. *Lycopodium australianum* gemma as shed from parent plant (1), with developing tap root (2, 3), with elongating stem and developing leaves (4, 5).

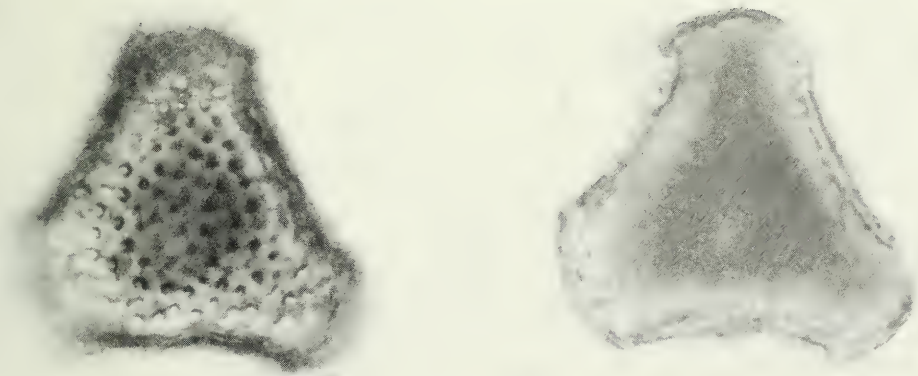


Fig. 3. *Lycopodium* spores from Palaeolake Nuggets deposit, layer 290 cm below present surface, approximately 10 000 years old. (a) distal face, (b) optical section, x420.

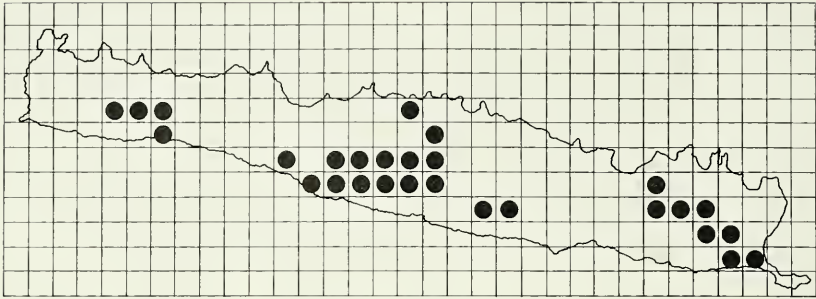


Fig. 4. Presence of *Lycopodium australianum* recorded in 1 km grid squares on Macquarie Island.

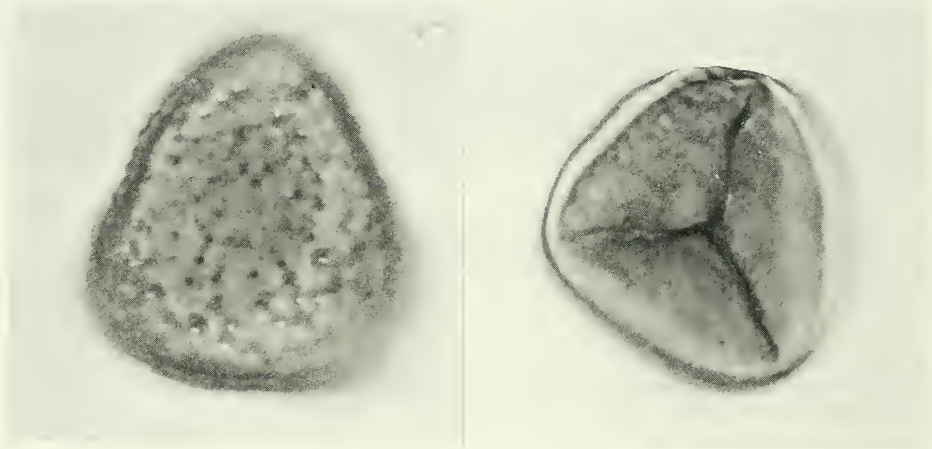


Fig. 5. Spores of (a) *Lycopodium varium* (distal face) and (b) *L. saururus* (optical section, x420) from Tristan da Cunha. Spore preparations loaned by N. Wace and J. Guppy.

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